The Journal of Laryngology and Otology
February 1992, Vol. **106**, pp. 116–119

The fibrous annulus in myringoplasty

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Abstract
Graft cholesteatoma is a serious complication of tympanic membrane grafting. It is due to burying keratinizing epithelium under the graft. Its occurrence in the anterior angle has been attributed to the presence of epithelial rests within the annulus in this area, and consequently is considered inevitable with overlay technique.

In the present study we propose that this complication is due to inadequate surgical technique rather than due to factors inherent in underlying pathology or in the technique itself.

Although myringoplasty technique has been largely perfected, it is far from being standardized. Controversies still exist, which may be of minor importance, *e.g.*, surgical approach (postaural, endaural or transcanal) or grafting material (autogenous fascia, perichondrium, homograft tissue). The most important controversy is the issue of onlay *vs* underlay techniques depending on whether the graft is placed lateral or medial to the annulus. The annulus is a fibrocartilagenous ring lodged in the tympanic sulcus. It is covered by skin with an epidermal layer that is transitional between that of the external meatus and the tympanic membrane, and lined by flat epithelium of the middle ear mucosa. In myringoplasty it provides support and nutrition for the graft and defines the level for graft placement.

It is generally agreed that although more difficult to master, the overlay technique gives better exposure, higher graft take rates, and preserves the normal depth of the middle ear space. However, problems with the onlay technique are cited to be more frequent and more important (Sheehy and Glasscock, 1967) namely lateralization, anterior blunting and epithelial cyst formation. This has led many otologists to condemn the technique. Although the first two can jeopardize the functional result, it is cyst formation that is the most serious and constitutes a definite risk to the patient. This complication is the focus of the present study.

If the graft is to be placed lateral to the annulus, its bed must be totally free of keratinizing epithelium. If viable squamous epithelial cells are buried under the graft, insidious development of epithelial cysts is inevitable (Hough, 1970).

Superficially developed cysts (lateral to the graft) are due to imperfect eversion of skin edges (Fig. 1). They present as tiny pearls in the drum substance. They do not constitute a real problem, they do not affect the outcome of surgery and generally call for no intervention.

It is the deep cysts that develop medial to the graft that concern us. They develop from overlooked keratinizing epithelium under the graft (Fig. 2). They may remain con-

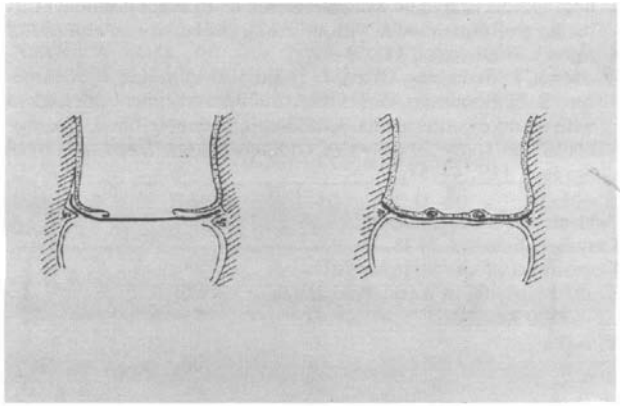

FIG. 1
Superficial pearly cysts due to improper eversion of the skin edges lateral to the graft.

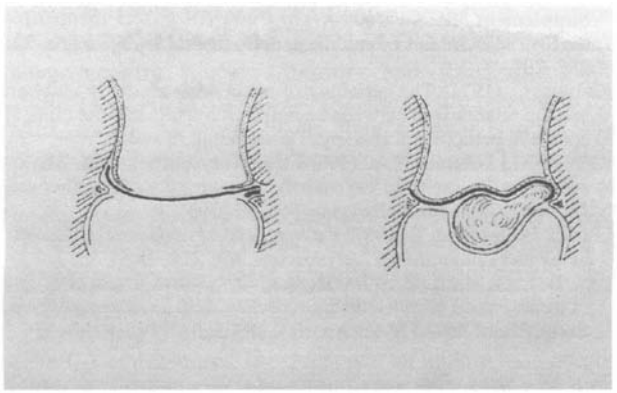

FIG. 2
Graft cholesteatoma due to burying keratinized epithelium under the graft.

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Accepted for publication: 16 October 1991.

FIG. 3

Creeping of stratified squamous epithelium around the edge for a distance of up to 4 mm on the under surface.

fined to the fibrous layer but eventually will grow to distend the epidermal layer laterally and penetrate the middle ear medially.

Plester and Pusalkar (1981) noticed that most of these cholesteatomata occur in the region of the anterior annulus. In a trial to explain this, they studied histologically 49 anterior tympanic rings and found out that the skin of the external auditory meatus does not just pass over the fibrous layer of the tympanic membrane. In 13 per cent of cases, cones of epithelium invade the subepithelial tissue.

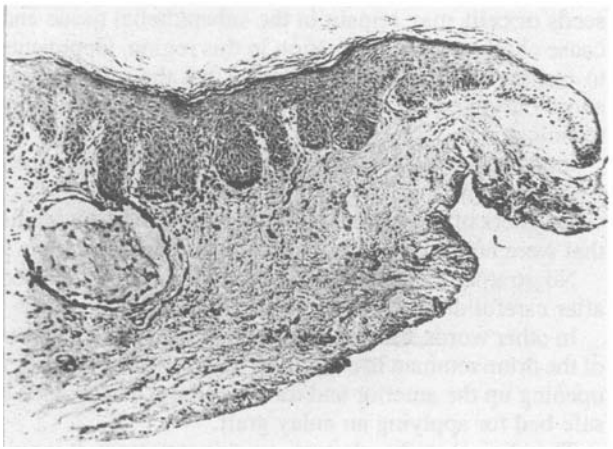

FIG. 4

Hyperplasia of surface epithelium with dipping of finger like or bulbous epithelial buds into the stroma.

This requires meticulous removal of skin from this area, a task which was considered by Hough (1970) very difficult since complete visualization is often impossible.

This finding led both authors to believe that cholesteatoma formation can follow overlay myringoplasty without any fault on the part of the surgeon due to the anatomical nature of this angle and the principle of the technique.

This study has been undertaken in an attempt to determine whether this defect is inevitable due to factors inherent in underlying pathology or in the technique itself or whether it results from inadequate surgery.

Material and methods

A. Histopathological study

Sixty cases of subtotal perforations in non-cholesteatomatous ears (operated during 1989 and 1990) were studied histologically by light microscopy. In half the cases, a piece of the anterior annulus with its covering epithelium was removed at the beginning of surgery, fixed in 10 per cent formaldehyde, embedded, sectioned at right angle, stained with haematoxylin and eosin and examined to determine:

Creeping of stratified squamous epithelium around the edge.

Type of epithelium covering the medial aspect.

Pathological changes in the subepithelial layer and within the substance of the annulus.

In the other half, a 2–3 mm piece of the anterior annulus was excised after dissecting the outer epithelial layer in continuity with the canal skin. These were prepared in the same manner and were studied mainly for any remnants of keratinizing epithelium to judge the adequacy of de-epithelialization and detect any separate epithelial cores within the fibrous annulus.

B. Clinical study

A retrospective study was made on 1500 consequative ears operated by the senior author. They constitute cases of total or large subtotal dry perforations operated by the same technique *viz* endaural onlay myringoplasty (Seifi, 1974) that were followed up for a minimum of three years.

Results

A. Histopathological study

Creeping of stratified squamous epithelium around the

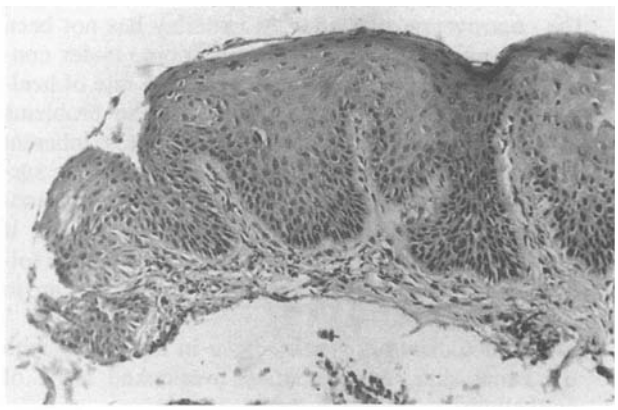

FIG. 5

Marked hyperplasia of surface epithelium with epithelial buds occupying most of the substance of the annulus.

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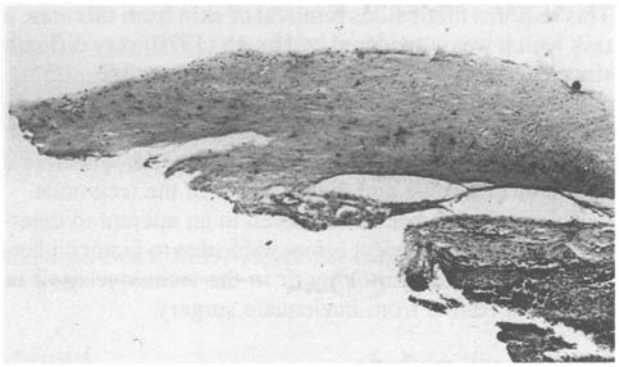

FIG. 6

Anterior annulus after dissecting the outer layer in continuity with canal skin. No remnants of stratified squamous epithelium can be detected.

edge occurred in 23 per cent of cases for a distance of up to 4 mm (Fig. 3).

The medial aspect of the tympanic membrane remnant was lined in 37 per cent of cases by epithelium ranging from cubical to pseudostratified columnar.

The subepithelial layer, even in dry ears with normal looking mucosa, was the seat of some pathological changes in over 80 per cent of cases. This may take the form of oedema, infiltration by acute or chronic inflammatory cells, tympanosclerosis, calcification, fibrosis. Glandular or cyst formation was rarely encountered.

The surface epithelium may show varying degrees of hyperplasia with finger like or bulbous dippings into the stroma (Fig. 4 & 5), but in no instance was keratinizing epithelium discovered within the fibrous annulus or on its medial surface that was not continuous with the surface epithelium.

De-epithelialization was adequate in all cases exam ined, *i.e.*, no overlooked islets of keratinizing epithelium could be detected (Fig. 6).

B. Clinical study

Out of 1500 ears, only 16 (1.06 per cent) developed cholesteatomatous cysts. If these ears are split into groups of 500, the incidence of these cysts was found to be 11 cases in the first group, four cases in the second and one in the third group.

Discussion

The controversy of overlay *vs* underlay has not been settled but overlay myringoplasty has come under considerable criticism, being blamed for a high rate of healling problems (Smyth, 1978). But are these problems really caused by the technique as such, by factors inherent in the pathology or are they actually caused by the surgeon? It is our conviction that most of the problems associated with overlay myringoplasty can be avoided if attention is paid to every detail during surgery. The following points in technique are worth stressing if we are to minimize complications.

1. De-epithelialization is carried out in continuity with the canal skin, thus avoiding overlooked islets of epithelium.
2. The anterior angle has to be opened up by bony removal in practically every case of total or subtotal perforation as well as in small anterior ones.
3. In total perforations, the handle of the malleus has to be incorporated in the graft which is inserted anteriorly in a pocket between the meatal bone in the prototympanum and the mucoperiosteum attached to the annulus, rather than everted up the bony meatus, a situation that may predispose to blunting.
4. The edge and a rim of the undersurface has to be removed all around the perforation to include any creeping around the edge.
5. Packing especially in the anterior and inferior angles has to be adequate and for a sufficient period preferably 15 days.
6. Complete haemostasis before placing the graft.

Two important features of the technique are noteworthy:

1. Preservation of as much as possible of normal tissues. This is important to provide support and nutrition as well as a large contact area.
2. Preservation of the normal topographic relation of the skin to drum and meatus. This ensures undisturbed migratory property and avoids raw areas in the canal with subsequent infection and stenosis.

The only unsolved problem really is the possibility of burying pathology. Staged procedures have taught us that when gross pathology is removed and the tympanic defect closed, many mucosal pathologies revert back to normal, *e.g.*, oedema, cellular infiltration and hyperplasia. Non-progressive pathology is of no consequence (fibrosis, tympanosclerosis, calcification). What concerns us is irreversible progressive pathology, *i.e.*, keratinizing epithelium, the precursor of a residual cholesteatoma. Doyle (1972) reported six cholesteatomas in 52 overlay myringoplasties. Plester and Pusalkar (1981) treated 48 cases of cholesteatoma in patients operated by the overlay technique from other clinics. In 27 of these cases, cholesteatoma was located in the region of the anterior annulus. They attributed this to the presence of epithelial cones, which they proved to be present in 13 per cent of normal ears, in this region invading even the subepithelial tissue. Similar findings were reported by Grunberg (1967) who found out that in some cases these cones might reach the fibrous layer. Most myringoplasties are performed on patients suffering from chronic middle ear disease. In such cases, due to chronic inflammation, the epithelial cones are likely to be even deeper. During de-epithelialization, due to the acute angle of the anterior annulus, some squamous epithelial seeds or cells may remain in the subepithelial tissue and cause cholesteatoma formation in this region. Opponents to overlay myringoplasty believed that the only way to avoid burying such epithelial cells is to use the underlay technique.

In the relatively small number of specimens examined we have found that:

No islets of epithelium were found within the annulus that were not in continuity with the surface epithelium.

No stratified squamous epithelium could be detected after careful de-epithelialisation.

In other words, careful dissection of the epithelial layer of the drum remnant in continuity with the canal skin after opening up the anterior and inferior angles can provide a safe bed for applying an onlay graft.

The clinical study substantiates this statement. It is evident that as more experience is gained and more attention is paid to meticulous technique, the possibility of burying keratinizing epithelium can be avoided.

https://doi.org/10.1017/S0022215100118845 Published online by Cambridge University Press

It is our impression that the findings of Plester and Grunberg are due to the angle of sectioning, *i.e.*, these islets represent inward dipping of the surface epithelium and can be removed with it. Besides, is it not logical to consider that the regular occurrence in the anterior angle is due to a 'difficult area' rather than variable histology in one segment of a single structure?

Conclusion

Most of the problems attributed to overlay myringoplasty, and epithelial cysts in particular, are iatrogenic and can be avoided or minimized by careful attention to details of technique.

References

Doyle, P. (1972) Tympanoplasty: should grafts be placed medial or lateral to the tympanic membrane. *Laryngoscope,* **82:** 1425–1430.

Grunberg, H. (1967) Zur Ursache des Rezidivcholesteatoms nach Tympanoplastik. *Zeitschrift fur Laryngologie und Rhinologie,* **3:** 199–204.

Hough, J. V. D. (1970) Tympanoplasty with interior facial graft technique and ossicular reconstruction. *Laryngoscope,* **80:** 1385–1413.

Plester, D., Pusalkar, A. (1981) The anterior tympanomeatal angle: the aetiology, surgery and avoidance of blunting and annular cholesteatoma. *Clinical Otolaryngology,* **6:** 323–328.

Seifi, A. E. (1974) Myringoplasty: repair of total or subtotal drum perforations. *Journal of Laryngology and Otology,* **88:** 731–740.

Sheehy, J. L., Glasscock, M. E. (1967) Tympanic membrane grafting with temporalis fascia. *Archives of Otolaryngology,* **86:** 381–402.

Smyth, G. D. L. (1978) Fifteen years report on tympanoplasty. Part II. *Journal of Laryngology and Otology,* **85:** 713–740.

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Key word: Myringoplasty